

HEALTH RISKS IN SILK INDUSTRY

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ABSTRACT

Sericulture is a labour intensive industry comprises cultivation of silkworm food plants, silkworm rearing, silk reeling, and other post-cocoon processes such as twisting, dyeing, weaving, printing and finishing. It provides an employment opportunity to large section of rural people, most of them being small and marginal farmers, or tiny & household industry mainly in the hand reeling and hand weaving sections. Even though, the silk is based on natural origin, the silk industry involves certain health risks in all the segments of silk processing from mulberry cultivation to silk finishing includes pesticides and herbicides toxicity from mulberry field, carbon monoxide poisoning, unhygienic rearing, use of bed disinfectants causing breathing problems and acts as carcinogens. Besides, grainage workers suffer from moth scales which trigger asthma and conjunctivitis. Workers of reeling units threatened by dermatitis, skin lesions, back pain, bronchial asthma in addition reeling and weaving operations generate a noise pollution. Workers are also suffer from gastric pains and physical aches during weaving and women get knocked about by the machines, which are in constant motion and their hands are cut often by the thread. Workers involved in dyeing, printing, and washing activities are suffer from coughs, gastrointestinal pains, ulcers, throat infections, thinning nails, dry skin, and hand and eye burning. The colours and materials used in dyeing and tracing emit strong smells, affecting their eyes, throats, nose, hands, and possibly internal functions. A large amount of fire wood is used for cocoon boiling and reeling. The smoke may emit toxic carbon monoxide (CO) fumes in to the air thereby causing pollution to the environment. Hot water and waste water from reeling and boiling, and dyeing waste from weaving goes into nearby areas such as crop fields and water bodies without proper treatment of the wastes. These effluents may kill microbes and other sensitive plants and animal in and around the disposal ditches and have impacts on agricultural crops and can

contaminate the drinking water bodies also. There is a need to build health consciousness and knowledge among sericulture workers about chemicals used in the various silk processes.

KEYWORDS: Sericulture, Health hazards, Risks in different silk processes, Control measures.

INTRODUCTION

The silk Industry, one of the productive cottage sectors in India is developing rapidly and lucratively over the past years. Clothing is the second important need and the factors like comfort, luxurious, traditional, elegance, quality, design, and fashion appeal play a significant role during cloth selection. Among the natural fibers - silk, cotton and wool, silk is known as the “Queen of Textiles” is a nature’s gift for human kind. India is one of the leading silk producing countries in world next to China. Among the four varieties of silk produced, mulberry accounts 74.51% (21,390 MT), Tasar 8.5% (2,434 MT), Eri 16.5% (4,726 MT) and Muga 0.55% (158 MT) of the total raw silk production of 28708 MT in 2014-15, Production of raw silk in India during the year 2015-16 (April to November- 2015) has been 19,070 MT in which, mulberry and Vanya raw silk output amounts to 12,954 MT and 6,116 MT, respectively (CSB report, as on 1st 2016). The workers of silk industry throughout the world are often getting allergies due to the presence of humidial environment, which favours the growth of allergy causing organisms like *Aspergillus fumigatus* and liberation of allergy causatives during the developmental stages of silk moth. Insect allergens have been identified as one of the major cause of asthma and allergic rhinitis (Chatrappa, 2000). Presently, the allergic proteins of adult silk moth were posing very severe threat to sericulture industrial grainage workers in causing allergic rhinitis, which is one of the most common disease in both developing and developed countries, Sericins from silkworm cocoon, moth and butterfly share a common allergenicity and silk allergy is caused not only by occupational but also by environmental exposure to the insects (Wen *et al.*, 1990). Silkworm products like fibroin manifests inflammatory response associated with type – I allergy (Kurosaki *et al.*, 1999).

Occupational diseases reflect health hazards brought on by exposure within the work environment. Due to lack of education, unaware of hazards of their occupations, general backwardness in the sanitation, poor nutrition and climatic proneness of this geographic region to epidemics aggravate their health hazards from work environment (Wang *et al.*, 2003). A respiratory problem has been reported in most of the countries with a textile industry. There are few studies on respiratory problems among textile workers in India

(Murlidhar *et al.*, 1995, Mathur *et al.*, 1993 and Jaiswal, 2004). Nilvarangkul (2006) showed that 63% of the women had respiratory problems such as asthma due to cotton dust, or respiratory irritation due to inhalation of chemicals used to bleach silk and cotton. The use of chemical dyes to colour the silk and cotton caused some women to develop allergic skin rashes.

Silk is known for its elegance, splendour and grandeur. But many processes in different sector of silk manufacture may cover a health hazards. The sericulture industry revolves around on mulberry cultivation, silkworm rearing and post cocoon silk processing. At every stage, sericulture workers are confronted with one or the other health risks with the spread of sericulture activities, the number of workers prone to hazards is also on the increase. So, the present review deals with the chances of health risks in sericulture industry and their control measures.

Health hazards in mulberry plantation

Health risk from using herbicides in mulberry

Glyphosate and 2-4-D are the two main herbicides used in mulberry ecosystems to control weeds. Both the herbicides are producing harmful carcinogenic substances. Over the past 40 years, dozens of studies have shown the connection between 2, 4-dichlorophenoxyacetic acid (2, 4-D) herbicide and cancers of the blood (Von Stackelberg, 2013). The International Agency for Research on Cancer (IARC) recently classified glyphosate as Class 2A probably carcinogenic to humans (Guyton *et al.*, 2015). It also causes endocrine disrupting effects in human cells lines, and reproduction effects (Gasnier *et al.*, 2009, Cassault-Meyer *et al.*, 2014).

Health risk from using pesticides in mulberry

Chlorpyrifos is used mainly to control termites in mulberry crop eco system. Poisonous gas emanates from chlorpyrifos affects the central nervous system, the cardio vascular, and the respiratory system in humans and causes irritation to skin and eyes. Dichlorvos (DDVP) is employed to control insect pest attack on mulberry, such as tukra, leaf roller and white fly. It causes neurophysiological and behavioural changes in human being. Dichlorvos chemically reacts with an important enzyme, acetyl cholinesterase and stops the functioning of brain (Colborn, 2006).

Pesticide exposure is mainly by the dermal route for preparation of sprays and by the dermal and inhalation routes during application. Ingestion might occur through consumption of contaminated food during or following work or through oral contact with contaminated

hands. Contaminated clothing is a significant source of exposure. Bystanders might be exposed to the sprayed pesticides dermally and *via* inhalation (WHO/UNEP, 2006). Chronic exposure to highly hazardous pesticides results in negative effects on skin, eyes, nervous system, cardiovascular system, gastrointestinal tract, liver, kidneys, reproductive system, endocrine system and blood (IPCS, 2010).

Health risk issues during silkworm rearing

Carbon monoxide

Carbon monoxide is known as a silent killer because it has no smell, colour or taste and produced by a faulty or poorly ventilated fuel-burning appliance such as partially burnt coal sigri used in Kashmir and other temperate areas causes nausea and vomiting. The other cause of accidental exposure to carbon monoxide (CO) is household appliances, such as cooking and heating devices, which have been damaged, incorrectly installed or badly maintained. Death of rearers was observed in rearing room due to CO beyond tolerance level (100ppm in Patnitop (J&K)). Cherry red lividity is seen in human body due to CO poisoning (Wani *et al.*, 2011).

Dermatitis

Workers of raw silk reeling units are mainly affected by Dermatitis, the skin lesions, localized mainly on the fingers, wrists and forearms, are characterized by erythema covered with small vesicles, which become chronic, pustular or eczematous and extremely painful. This is mainly due to the decomposition products of the dead chrysalis and to a parasite in the cocoon (Pandey *et al.*, 1993). While cocoons are put in hot water to loosen silk fibers for unwinding, the workers also put their bare hands in hot water, resulting in blisters in their hands leading to secondary infection, such as dermatitis.

Respiratory tract problems and noise pollution

A kind of tonsillitis oftenly occurs among silk spinners due to a bacterial infection from the silk cocoons. Sometimes, workers in the natural silk industry may develop respiratory allergy featuring bronchial asthma, asthmatiform bronchitis and/or allergic rhinitis (Subramani *et al.*, 2015).

Persons who are involved in reeling and throwing operations reach harmful levels of noise at the time of spinning and winding the silk threads and at looms where the fabric is

woven. Areas in sericulture such as reeling and weaving also generate a great deal of noise pollution (Subramani *et al.*, 2015).

Other health hazards

Unhygienic conditions due to accumulation of unutilized leaves and silkworm excreta pose health risk. Any negligence of hygiene leads to silkworm mortality due to two main diseases Grasserie & Flacherie. The dead silkworms, if not removed immediately, putrify and cause illness among rearers. In grainage, inhalation of fumes during acid treatment of bivoltine eggs and dyeing of silk fabrics using acid baths may cause respiratory disorders. Asthma (believed to be allergic in nature) could be triggered by fine scales in the air released by the fluttering of the silk moths wings during mating. Male silkworms release more scales as they flutter more frequently during mating (Venkatappa *et al.*, 2005).

During silk reeling, smoke is emitted from cocoon cooking stoves from firewood and the stench from steam and vapour arising from fluids released from the pupa body leads to asthma. Few reports regarding the incidence of occupational asthma in sericulture in China and Japan are available (Ramanathan, 1997). Bronchial asthma also observed among the workers of silk reeling units due to the air borne antigens originating from silkworm cocoons and pupae. Reelers develop back pain as they stand and work for 8 hours. Workers who boil the cocoons mentioned that they do not use any gloves or masks. They get severe headaches, gastric pain, and skin burning as they are always exposed to the fire and fumes emitted from the boiling. (BCAS, 1997).

The people engaged in silk reeling units are prone to fungal and other skin infections like dermatophytosis (ring worm infection) due to constant immersion of hands during reeling in hot and tepid water. Sometimes, this water is often laced with certain chemicals to improve the colour or quality of silk. The feet also become infected due to constant contact with damp floors caused by improper and unhygienic drainage systems followed in reeling units (Nasima *et al.*, 1998).

In weaving process, women get knocked about by the machines, which are in constant motion and their hands are cut often by the thread. Repetitive motions involved in weaving causes stress on the muscles. Some of the workers also suffer from gastric pains and physical aches. Workers involved in dyeing, printing, and washing activities are suffer from coughs, gastrointestinal pains, ulcers, throat infections, thinning nails, dry skin, and hand and eye burning.

Pentachlorophenol, which is used in spray starch before ironing silk garment to protect from mould attack also, poses severe health problems. Formaldehyde resins routinely applied on silk to reduce shrinkage and wrinkling, cause eczematous rashes. Contact with silk cloth with a pH outside the accepted range (5.5), turns the skin flora out of balance and causes irritation. Dermatitis, narcosis, dizziness, fatigue, nausea, headache, eye irritation, adverse reproductive hazards including risk of miscarriage and serious neurological problems can all result from the processes of screen printing, where toluene, xylene and methyl ketone are used as solvents of the inks, thinners and clean up materials (Rakesh, 2014).

The colours and materials used in dyeing and tracing emit strong smells, affecting their eyes, throats, nose, hands, and possibly internal functions. Tracing chemicals burns hands and eyes and stains fingers and nails. Trivalent chromium used to fix silk dyes undergoes oxidation into hexavalent chromium, leads to skin irritation, ulcers, sensitization and allergic contact dermatitis. Lead acetate used in dyeing silk cloth is a neurotoxin. It affects the human brain as well as reproductive system (BCAS, 1997). Workers cannot use gloves during tracing because the gloves melt from the kerosene and zinc oxide. Workers were not observed to use gloves for mixing dyes either. They wash chemicals off their hands with normal soap.

Effect of hazards on environment

Waste water and solid waste disposal are the main cause of environmental effects. There are many chemicals, pesticides and fertilizers used in the different stages of sericulture activities, including plantation, rearing, grainage, and weaving. These will have a harmful effect on the environment and public health if they are not handled and disposed properly. Fertilizers and pesticides used in mulberry plantations may have an effect on the silkworm life cycle and the quality and quantity of cocoons produced as well as poses negative impacts on the environment (Zaman *et al.*, 1996).

A large amount of fire wood is used for cocoon boiling and reeling. The smoke may emit toxic carbon monoxide (CO) fumes in to the air. Use of firewood also adds to forest destruction. Dye factories across the world are dumping millions of tons of dye effluent into rivers without any effluent treatment. Hot water and waste water from reeling and boiling, and dyeing waste from weaving goes into nearby areas such as crop fields. These effluents may kill microbes and other sensitive plants and animal in and around the disposal ditches and have impacts on agricultural crops (Berube, 1996).

Effect of bed disinfectants (Paraformaldehyde)

Bed disinfectants employed during silkworm rearing mainly consist of slaked lime and paraformaldehyde. Human Skin contact with bed disinfectants result in sensitization, inflammation of the eye (redness, watering and itching).

Formalin is commonly used disinfectant in sericulture industry and the effectiveness of disinfectants depends on the concentration, duration of contact and ambient temperature and RH. For effective use of formalin the rearing space to be disinfected should be made air tight and mixed with 0.05% detergent solution. Formaldehyde is a sensitising agent that can cause an immune system response upon initial exposure. It is also a cancer hazard. Acute exposure is highly irritating to the eyes, nose, and throat and can make anyone exposed cough and wheeze. Subsequent exposure may cause severe allergic reactions of the skin, eyes and respiratory tract. Ingestion of formaldehyde can be fatal, and long-term exposure to low levels in the air or on the skin can cause asthma-like respiratory problems and skin irritation such as dermatitis and itching. Concentrations of 100 ppm are immediately dangerous to life and health (IDLH). Use of formalin without certain precautionary measures causes burning eyes, mucus secretion, and peeling skin (Pandey *et al.*, 1993).

Bleaching powder is an amorphous powder with a pungent smell of chlorine and is also called as chlorinated lime powder used as a disinfectant. Bleaching powder solution at higher concentration than >50% causes health hazards. The application of dust formulations may cause respiratory disorders and burning eyes (Ramanathan, 1997).

Effect of bleaching agents

Hydrogen peroxide is the popular oxidizing bleaching agent for silk fibres. Inhalation of H₂O₂ during disinfection of silkworm rearing room affects the workers. It is a mutagen; handle it as a possible carcinogen – with extreme caution. It is also possible to causes mutations (genetic changes). Inhaling hydrogen peroxide can irritate the nose, throat, lungs causing coughing and shortness of breath. Higher exposures may cause a build - up of fluid in the lungs (pulmonary edema), a medical emergency, with severe shortness of breath. Exposure to H₂O₂ can cause headache, dizziness, nausea and vomiting. Contact can severely irritate and burn the skin and eyes with possible eye damage (Oberst, 1984). Hydrogen peroxide is reactive and a dangerous explosion hazard. H₂O₂ is not combustible but it is a strong oxidizer which enhances the combustion of other substances.

Potassium permanganate causes acute health effects as same as to H₂O₂. In addition to that, potassium permanganate may decrease fertility. Long term exposures may affect the liver and kidneys.

Hazard Control Measures

The best way to protect workers is to remove or eliminate the hazard from the work place using the following hazard control methods: Substitution. Substitute dangerous chemicals, equipment or work methods with safer and less hazardous ones to eliminate the hazard altogether. Engineering controls are used to make changes to the work environment, machine or piece of equipment, often reducing the hazard at the source. Example: Exhaust ventilation can be used to remove a harmful substance such as carbon dioxide (dry ice) from the air.

- Provide regular health check-ups to the workers of sericulture industry and glasses for those who need them.
- Use gloves and masks to prevent the health hazards during various activities such as dyeing, weaving and reeling in silk processing.
- Nose and ears needs to be protected by mask or cloth at the time of bed disinfectants application. If, any disease worm is noticed before application it need to be screened to have check on pathogen.
- Most of the disinfectants are effective for a period of 6 months to one year. Before its application its expiry should be checked (Balavenkatasubbaiah *et al.*, 1987) and dispose the used empty container in the soil by means of burying or burning (Sharma, 2006).
- All protective clothing (suits, gloves, foot wear, head gear) should be clean, available each day, and put on before work. Dress indirect-vent, impact and splash resistant safety glasses when working with liquids.
- Wear a face shield along with spectacles when working with corrosive, highly irritating or toxic substances. Do not wear contact lenses when working with the harmful elements.
- Care should be taken to avoid inhalation of acid fumes by providing proper exhaust and ventilation facilities in grainages and dyeing units which facilitates the quick dispersal of fumes.

- Workers should use lab coat and gloves to avoid the moth scale allergens during grainage activities.
- During dissection and crushing of moths for pebrine examination, try to hold the insects so it doesn't spread dusty particles.
- The presence of exhaust fans in the pairing/oviposition rooms reduces the concentration of scales in the grainage environment.
- An antifungal skin ointment to be used on hands and feet for preventing skin disease
- Workers should be trained on its proper handling and storage of harmful substances.
- Label the process containers.
- Workers whose clothing has been contaminated by bleaching agents should change into clean clothing promptly.
- Eye wash fountains should be provided in the immediate work area for emergency use.
- If there is the possibility of skin exposure, emergency shower facilities should be provided.
- After the completion of disinfection, wash any areas of the body that may have contacted with bleaching substances, whether or not known skin contact has occurred.
- Do not eat, smoke, or drink where the harmful chemicals are handled, processed, or stored, since the chemical can be swallowed.
- Wash hands carefully before eating, drinking, smoking or using the toilet.
- Use a vacuum or a wet method to reduce dust during clean – up.
- Replacement of conventional firewood system with gasfier systems.
- Efficient energy utilization by upgradation of labour skill reduces pollution level.

CONCLUSION

Good preventive maintenance plays a major role in ensuring that hazard controls continue to function effectively. The study reveals that the imperative need to build health consciousness among sericulture workers. Training should be given to the workers of the industry about the possibility of health risks and their prevention. The health hazards control measures should be taken implemented with government and non - governmental agencies for mitigating the health hazards in sericulture industry. Awareness programme and local group discussions are essential for improving the health status of the sericulture workers.

Every sericulture unit should have a provision of protecting equipments such as face masks, first aid facility, gloves and proper uniform.

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